

THE REMEDIES EMPLOYED
IN
CARDIAC AFFECTIONS
AND THEIR INDICATIONS.

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THE

REMEDIES EMPLOYED IN CARDIAC AFFECTIONS AND THEIR INDICATIONS.

MR PRESIDENT,—When invited by you to take part in a discussion on the subject of Cardiac Therapeutics, I gladly consented, for the subject is one of great importance to all practitioners of medicine, who, also, by the statement of their practical experience, cannot fail to contribute much information useful for guidance in the treatment of heart affections. Cardiac affections, further, are every day before us, and the number of cases seems to be increasing. They nearly always present themselves in circumstances demanding grave consideration; not only because of the disorders produced by a deranged circulation, but also because of the anxiety and distress which are associated with even the less important of their forms.

In the majority of instances, however, they also present themselves as affections in which, notwithstanding associated dangers and anxieties, the physician, by the judicious selection and employment of remedies, can confer more conspicuous benefits than in the case of the greater number of other serious affections.

This gratifying result is most frequently obtained by the administration of substances possessing the fundamental action of digitalis,—the remedy which for the longest period of time has been employed in the treatment of heart diseases, and which, also, has been the substance first used by pharmacologists to define a type of action obviously beneficial in the greatest number of the disorders of the heart. The definition of the action of digitalis, however, was not obtained until many years after it had become widely known as a cardiac remedy, on the recommendations contained in Dr Withering's *Account of the Foxglove and some of its Medical Uses*, published in 1785.

It remained for pharmacological investigators—prominent among whom must be mentioned Claude Bernard—to determine the true action of digitalis; and, indeed, it is only recently that we, as

practitioners, have come to understand the action, and thereby to be able to employ this valuable remedy with a precision before unattainable. We now realise that when we administer it we do not, as was formerly supposed, in any true sense produce a sedative action on the heart, but the much more valuable one of strengthening its contractions and thus increasing its capability to overcome causes impeding the circulation of the blood.

This important fact in the action of digitalis having been ascertained, it has since been found that there are many other substances which also are able to produce these effects. While possessing the same chief effects as digitalis, and therefore being properly grouped along with it in action and therapeutic capabilities, it has also been found that differences exist among them in regard to physical properties and pharmacological effects.

Experience has also shown that digitalis does not in all instances succeed in producing the therapeutic benefits that were anticipated, and that its use is not unfrequently attended with inconveniences, and even with unexpected dangers. With the desire, therefore, of obtaining a serviceable substitute, many of the other substances that possess the fundamental action of digitalis have been employed in the treatment of cardiac disease.

The evidence in regard to many of them is, in the meantime, insufficient to decide the great practical question of their relative value, both on positive and negative grounds; but the attention which has been given to their effects, and the endeavours which have been made to define their value in cardiac diseases, has at least had the important result of emphasizing the nature of the fundamental changes of the heart's action which they produce, and which constitute their chief therapeutical value.

Each of the substances in the group is able to strengthen the contractions of a labouring and disabled heart; but there can be no doubt that, owing to the special nature of the disability or the relative frequency of its occurrence, there are certain forms of cardiac affection in which more frequently than in others is exemplified the success with which the many and distressing consequences of cardiac disability may be removed by them.

General experience concurs in assigning this position to the cardiac disability produced by mitral valvular disease, and especially to regurgitation at this orifice.

The following cases illustrate the nature of this therapeutic benefit. In them, as well as in others which I propose to describe, the special remedy of the group by which the benefit has been produced was *strophanthus*, the seed of *Strophanthus hispidus*. I have taken this substance for the purposes of illustration, more because my experience with it has been larger than with any other similarly acting substance, than, in this aspect of the subject, to draw any special comparison between it and these other substances.

I propose to take my illustrative cases, also, from only the more severe types of cardiac disease, in order the more clearly to show the unequalled therapeutic benefits which substances of this pharmacological group are capable of producing.

Mitral Lesions—Regurgitation.

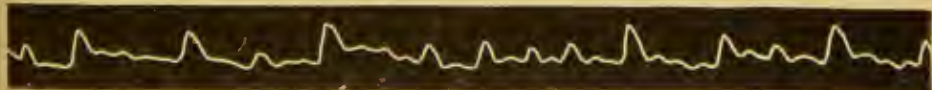
Susan S., a married woman, aged 42, was admitted to Ward 25, Royal Infirmary, on the recommendation of Dr Church, suffering from dyspnœa, palpitation, sleeplessness, dyspepsia, vomiting, cough, and moderate œdema of the lower extremities. She ascribes her illness to a severe "cold" two years previously. She has not suffered from rheumatic fever.

On admission, the pulse was very feeble, irregular, and rapid; there was precordial pain; the heart's impact was scarcely perceptible; and a systolic mitral bruit was audible. The lungs were congested and œdematous, and the urine scanty, very albuminous, and of the specific gravity of 1030.

No special cardiac treatment was adopted until eight days after her admission; but rest in bed and careful dieting having failed to produce any improvement in her condition, she was ordered 6 minims of tincture of strophanthus thrice daily.

In a short time, the rapid pulse-rate of between 160 to 130 per min. was slowed to 90, and then to 80, and 70; she was able to sleep longer than before; the breathing became easier; and the œdema of the lower extremities entirely disappeared. More slowly, the appetite was recovered, and the pulmonary symptoms and precordial pains disappeared. The patient left the hospital in five weeks, feeling strong and well.

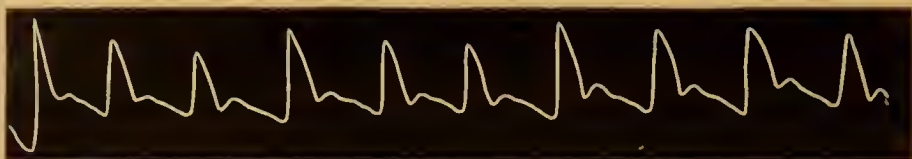
Before strophanthus was administered the pulse was very feeble and rapid; on the day after its administration had been commenced the rate was 96, and the strength greatly increased; on the third day the rate was still 96, but the irregularity was less; on the sixth day the rate was 88, with still less irregularity; but even a few days before she left hospital, when the rate of pulse had been reduced to 55, an irregularity every now and then occurred in the rhythm.



Susan S.—Immediately before Strophanthus, eight days after admission. Pulse 116, respirations 40, per min.



Susan S.—First day of Strophanthus. Pulse 96, respirations 36, per min.



Susan S.—Fifth day of Strophanthus. Pulse 88, respirations 32, per min.



Susan S.—Twentieth day of Strophanthus. Pulse 55, respirations 22, per min.

During the first six days following the admission of the patient into the hospital, the average daily quantity of urine was 24 ozs.; on the day following the commencement of treatment, the amount was 50 ozs.; on the third day, 94 ozs.; on the fourth day, 62 ozs.; on the fifth day, 80 ozs.; and on the sixth day, 70 ozs., before which day the superficial œdema had altogether disappeared.

John B., 55, a porter at Bo'ness Docks, was admitted complaining of great weakness, of being unable to walk without assistance, of shortness of breath, sleeplessness, cough, palpitation, and swelling of the body. He had been very intemperate in his habits. The above symptoms had followed night-work in very inclement weather, six weeks before the patient's admission into hospital.

It was found on examination, that the patient had general anasarca and bronchitis; that the liver was considerably enlarged; and that the heart was dilated, and the mitral orifice incompetent. The urine was scanty in amount, but not albuminous.

On the fifth day after the admission of the patient, he was treated with tincture of strophanthus in doses of 8 minims thrice daily. On the night of the following day, he slept fairly well, and his subjective symptoms had become much lessened, but the cough was still troublesome. The œdema quickly subsided, and the liver dulness gradually diminished; but some enlargement still remained on his leaving the hospital, four weeks after the treatment had been begun. The improvement in the heart's action is shown in the following pulse tracings:—



John B.—Before Strophanthus, five days after admission. Pulse 84, respirations 24, per min.



John B.—First day of Strophanthus. Pulse 88, respirations 24, per min.



John B.—Fifteenth day of Strophanthus. Pulse 82, respirations 28, per min.



John B.—Twentieth day of Strophanthus. Pulse 68, respirations 19, per min.

During the four days preceding the first day of the administration of strophanthus, the urine averaged 27 ozs. per diem. On the first day of treatment, the quantity was 46 ozs.; on the following day, 56 ozs.; on the third day, 126 ozs.; on the fourth day, 116 ozs.; on the fifth day, 116 ozs.; and on the eighth day, 70 ozs.; and by this time the dropsy had disappeared.

Combined Mitral and Tricuspid Lesions.

The following case illustrates the therapeutic benefits in the serious condition produced by a combination of mitral and tricuspid disease, co-existing with emphysema and bronchitis.

John B., aged 52, a cabman, was admitted into the Royal Infirmary suffering from cough, orthopnoea, general anasarca with great swelling of the legs and scrotum, and extreme weakness. He had not been very alcoholic in his habits, but had necessarily been much exposed to cold and wet. Cough had existed for twelve months, marked difficulty in breathing for six months, and oedema for eight weeks.

On admission; there were, in addition, cyanosis, an appearance of great distress, congestion of the superficial veins, with distended and pulsating jugulars, giving evidence of regurgitation through the tricuspid orifice; the tricuspid and mitral valves were incompetent; the heart was dilated and acting feebly; and there was emphysema with bronchitis and oedema of the lungs. Six days after admission, treatment with strophanthus was commenced in doses, during the first twenty-four hours, of 4 minims of the tincture every two hours, and, subsequently, every eight hours. An improvement was manifest in the action of the heart within two hours after the first dose had been administered, and the improvement steadily advanced, until on the second day the pulse was 78 per minute and of good quality, and on the fifth day the left ventricle was acting with much strength. The quantity of urine became simul-



John B.—Day before Strophanthus, the sixth day after admission. Pulse 96, respirations 28, per min.



John B.—First day of *Strophanthus*, two hours after first dose. Pulse 92, respirations 25, per min.



John B.—Third day of *Strophanthus*. Pulse 78, respirations 21, per min.



John B.—Sixth day of *Strophanthus*. Pulse 78, respirations 18, per min.



John B.—Sixth month of *Strophanthus*. Pulse 64, respirations 20, per min.



John B.—Seventh month of *Strophanthus*.

taneously increased, so that on the second day of treatment it amounted to 64 ozs., as contrasted with an average of 15 ozs. daily before treatment, on the third day to 90 ozs., on the fourth day to 60 ozs., on the fifth day to 56 ozs., on the sixth day to 76 ozs., on the seventh day to 79 ozs. At this time, as the supply of tincture with which the patient was being treated had failed, there was substituted for it a tincture dispensed in the Laboratory of the Infirmary. The change was an unfortunate one, for the action of the heart and of the kidneys and the symptoms of the patient soon began to deteriorate. As the addition of acid tartrate of potassium failed to restore the free elimination of urine, and as the œdema and distress of the patient became rapidly aggravated, fluid was drawn from the legs by Southey's tubes, and, soon afterwards, a free discharge of urine occurred, and the patient again steadily improved without any further relapse.

Before passing from the illustration of the valuable therapeutic effects of these agents in auriculo-ventricular lesions, it may be pointed out that the direct and uncomplicated effects of mitral stenosis are not so conspicuously benefited by them as are those of regurgitation. It is obvious that the relatively small muscular structure of the left auricle does not afford much opportunity for

the action of a remedy which produces its benefits by increasing the contractile energy of the heart's muscle. Fortunately, however, mitral stenosis is a lesion in which compensation is generally fairly successfully established by spontaneous changes, and if the patient is careful not to over-tax the heart, the asystole of non-compensation and the consequent need for treatment by cardiac tonics of this group may be delayed for many years.

Aortic Lesions.

In this respect, but with a more perfect production of compensation, aortic lesions have a resemblance to the lesion of mitral stenosis. In both stenosis and regurgitation at the aortic orifice the left ventricle usually accommodates itself to the difficulties that are produced, and, especially in stenosis, the compensation thus spontaneously produced may continue for an indefinite time. Injury rather than good is done in these circumstances by the administration of any substance of the group I am now considering. The heart is unduly stimulated and the muscle of the left ventricle becomes hypertrophied beyond the needs of the circulation. The nutritive requirements of the unnecessarily hypertrophied heart become increased, and they may at any moment, and from a diversity of causes, in themselves of trivial importance, become insufficient to maintain the myocardium in a condition of health. Compensation is thus destroyed, and the very evil which should most carefully be guarded against in aortic disease, and which, perhaps, in the course of time inevitably occurs in the majority of cases, is precipitated by improper treatment.

This evil is all the more likely to be produced if the substance administered is not only a tonic of the heart-muscle but also of the bloodvessels; and, even more, if its constricting action on bloodvessels exceeds its power to increase the contractile energy of the heart's muscle,—the characteristics, as I shall afterwards point out, of the action of digitalis.

But even while compensation is being fairly well maintained in aortic disease, the mere mechanical results of the hypertrophy that has produced compensation, the pathological changes that so frequently occur in the hypertrophied muscle long before asystole takes place, and the advance of the arterio-sclerosis so usually associated with aortic disease, originate a group of symptoms widely differing from those encountered in uncomplicated auriculo-ventricular lesions. They constitute the phenomena of that most distressing condition, cardiac angina; but even when present in their most severe type they are not in themselves indications for the administration of cardiac tonics. Their successful treatment, in the absence of independent evidences of non-compensation, is rather to be found in the administration of opium and similarly acting bodies, of nitro-glycerine and nitrites, and of arsenic and iodide of potassium. The most certain of these remedies is opium,

but there are circumstances in which the others also are administered with valuable results. As to nitro-glycerine and the nitrites, while recognising their great value in many cases, and especially where the heart symptoms are aggravated by bronchial spasm, I have found that, like probably all other remedies employed to cure a group of symptoms originating from a diversity of causes, they not infrequently fail to give relief. The powerful and rapid action which they possess in dilating bloodvessels is believed to supply the explanation of their therapeutic benefit. In regard to this explanation, and to the spasm of bloodvessels as a cause of the angina, which is implied in the explanation, I have observed angina to occur while the arterial tension remained low, and nitrites to succeed where no obvious effect was produced upon the tension, and I have also observed nitrites to fail where a high tension was greatly reduced by their administration.

As to the administration of iodide of potassium, I am unable to recognise any sufficient modification of the circulation produced by it in therapeutic doses that can afford an explanation of the benefits following its administration. In large doses, it undoubtedly quickens and enfeebles the heart's contractions, but at the same time it renders them irregular; while some experiments which have recently been made in my laboratory by Dr Sillar show that by direct contact, both in large and in small quantities, it produces no marked effect on the condition of the bloodvessels. Its beneficial effects are more probably to be explained by its action on the pathological processes occurring in the aorta and heart, and especially on the fibroid changes that have been there produced. I would, however, leave the further discussion of this subject to Dr George Balfour, from whom we have already learned much regarding the employment of iodide of potassium in aortic diseases.

Still, even on the more characteristic symptoms of aortic lesions, the action of substances acting directly on the cardiac muscle by strengthening its contractions is sometimes found to be a beneficial one, as the following case exemplifies.

Robert L., aged 57, a labourer in an iron foundry, came under my care suffering from precordial pain and intense dyspnoea, both having paroxysmal exacerbations, and from cough, shortness of breath, and anasarca. He had been unusually alcoholic after the death of his wife, which occurred ten weeks before admission; a week afterwards, he strained himself while lifting a heavy weight, when he immediately experienced an aching pain in the chest and sudden general weakness. Five weeks before admission, swelling began in the feet and ankles, and three weeks afterwards a severe cough occurred. All these symptoms having become aggravated notwithstanding treatment, he was sent to the Infirmary by his employers.

On admission, the more striking external morbid phenomena were great cedema of the lower extremities, and marked cedema of

the face, which was also cyanosed and jaundiced; enlargement of the abdomen; and an agonizing condition of dyspnœa, preventing sleep, so that, he said, he had slept only six or seven hours in all for the last six days.

He had a characteristic aortic regurgitant pulse, regular and easily compressible, with capillary pulsation, and distended and pulsating veins. The cardiac impact was not visible, but the apex shock could be felt at the sixth rib, nearly two inches to the left of the nipple line. On auscultation, a double aortic murmur was found to be present, and the other valves to be unaffected. Rhonchi and coarse crepitations were heard over a great part of the lungs, and the chest was somewhat barrel-shaped. The breathing was laboured, and it was, by-and-by, observed to have the Cheyne-Stokes characteristics. There was a moderate amount of fluid in the abdomen, but its enlargement was mainly due to an increase in the size of the liver, which measured $9\frac{1}{4}$ inches in the mammillary line.

The case, therefore, presented in an extreme form the symptoms of aortic disease in which compensation had not been established, and in which, therefore, there was occasion to adopt a treatment more generally found beneficial in auriculo-ventricular disease than in the comparatively early stages of aortic lesions. In the first place, however, an attempt was made to relieve the condition by hypnotics, expectorants, and external applications; but as no success was obtained, 5 minims of tincture of strophanthus were administered every four hours on the fourth day after his admission, on the following day every six hours, and on the ninth day every eight hours. Beneficial effects were rapidly produced. On the day before treatment, the pulse-rate was 103. On the day following the commencement of treatment, it had fallen to 70 per minute, and the previous continuous dyspnœa, with frequent intervals of orthopnœa and of Cheyne-Stokes breathing, was rapidly improved, so that on the eighth day of treatment the respiration was quite normal. The anasarca lessened, until on the twelfth day it had altogether disappeared; the enlargement of the liver subsided gradually, so that on the fifth day the length of the line of liver dulness in the mammillary line was $8\frac{1}{4}$ inches, and on the nineteenth day $5\frac{1}{4}$ inches, as contrasted with $9\frac{1}{4}$ on the day before commencing the administration of strophanthus; and the previous weight of 11 stones $4\frac{1}{2}$ lbs. had become reduced on the twelfth day to 9 stones $7\frac{3}{4}$ lbs.

Although there was no opportunity in the existence of a pulse of aortic regurgitation to produce, by the action of any substance acting on the cardiac contractions in the manner of the strophanthus group, the striking changes often observed in the small, irregular, and weak pulse of auriculo-ventricular diseases, nevertheless an effect, as well marked as in these latter conditions, was produced on the secretion of urine. During the four days

preceding the administration of strophanthus, the amounts of urine passed were 26, 24, 18, and 20 ozs., and it contained a little albumen. On the day after administration, the amount was 34 ozs., on the second day 46 ozs., on the third day 100 ozs., on the fourth day 116 ozs., on the fifth day 86 ozs., on the sixth day 62 ozs., on the seventh day 102 ozs., and on the eighth day 102 ozs. Albumen disappeared on the fifth day of treatment. No relapse occurred, but as precordial pain now and then was suffered from, the patient remained in hospital for three months, and during all that time he continued to receive tincture of strophanthus.

But, as I have indicated, almost inevitably, in the course of time, cardiac degeneration occurs in aortic disease. The hypertrophied heart-muscle is no longer able to maintain a sufficient circulation; dilatation with auriculo-ventricular regurgitation frequently occurs; and, whether this complication exist or not, the symptoms of cardiac insufficiency that are produced are indistinguishable from those of auriculo-ventricular regurgitation. It is now that the administration of cardiac tonics is indicated, and in many instances they, for a time at least, produce as remarkable therapeutic results as in the non-compensation of auriculo-ventricular lesions. From many cases in which this complication existed I select the following:—

Combined Aortic and Mitral Lesions.

James M., 65, a tailor, came under my care suffering from general weakness, difficulty in breathing, swelling of the legs and body, and pain over the heart. Many of these symptoms had originated a year previously, but the weakness and cardiac pain had lately much increased.

It was found that the heart was hypertrophied and dilated, that there were systolic and diastolic aortic and systolic mitral murmurs, that the pulse was extremely feeble and its rate between 137 and 146 per minute, and that the arteries were moderately atheromatous. It was considered advisable to treat the cardiac weakness as soon as possible, and, accordingly, on the night of admission tincture of strophanthus was administered in 5 minim doses every four hours. The pulse tracing before treatment was represented by almost a straight line, but it slowly improved, until on the seventh day of treatment a movement of fair amplitude and regularity was obtained, but still at the increased rate of 94 per minute.



James M.—Before Strophanthus. Pulse 136, respirations 36, per min.



James M.—Seventh day of Strophanthus. Pulse 92, respirations 18, per min.

In this case the urine on the day before treatment amounted to only 24 ozs.; in the first twenty-four hours of treatment it had increased to 84 ozs., on the second day to 140 ozs., on the third day to 130 ozs., on the fourth day to 108 ozs., on the fifth day to 120 ozs., on the sixth day to 110 ozs., on the seventh day to 70 ozs., on the eighth day to 80 ozs.; and it afterwards varied from 78 to 40 ozs. That this great diuresis was produced by strophanthus is not, however, so clearly evident as in the former cases, for the preliminary stage of observation without treatment was too brief a one. The patient was dismissed in twenty-eight days free from all urgent symptoms, and able for light work.

Joseph M., 28 years of age, was admitted into the Royal Infirmary with a history of rheumatic fever, which had occurred seven years and also four years previously; and suffering from palpitation, dyspnœa, pain over the heart, cough, weakness, and occasional vomiting. The pulse was slow and irregular, but otherwise presented the characters of aortic regurgitation combined with stenosis. The heart was much enlarged, with a diffuse apex impact in the 6th interspace, $5\frac{1}{4}$ inches to the left of the mid-sternal line. There was mitral regurgitation, with both regurgitation and stenosis at the aortic orifice, and a moderate degree of œdema of the base of both lungs, but none elsewhere. On the third day after admission, he was treated with tincture of strophanthus in 5 minim doses thrice daily. The palpitation, dyspnœa, and other symptoms soon subsided, and the pulse became stronger and nearly regular. A distinct effect was also produced upon the urine. During the three days preceding the administration of strophanthus it averaged only 18 ozs. a day; on the day following the administration it had increased to 24 ozs., on the second day to 70 ozs., on the third day to 68 ozs., on the fourth day to 58 ozs., on the fifth day to 62 ozs.; and this satisfactory elimination was maintained so long as strophanthus was being administered. In about a month, however, the condition had so long continued a favourable one that the treatment with strophanthus was stopped. The pulse very soon again deteriorated, and some of the original symptoms returned; but on resuming the treatment the former condition of good health was restored, with a corresponding improvement in the heart's action.



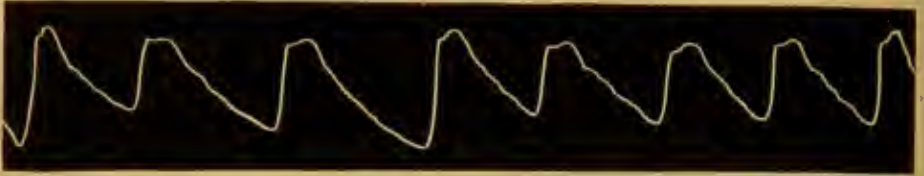
Joseph M.—Before Strophanthus. Pulse, (?); apex shocks about 120 per min.; respirations 25 per min.



Joseph M.—During Strophanthus, eighth day. Pulse 64, respirations 19, per min.



Joseph M.—Twelve days after Strophanthus stopped. Pulse 91, respirations 22, per min.



Joseph M.—After resuming Strophanthus. Pulse 64, respirations 20, per min.

Aortic Regurgitation with Cardiac Degeneration.

The final result was not so favourable in the next case of aortic disease.

The patient was a man, George C., 59 years of age, recently a clerk, but formerly a soldier. He was admitted suffering from sleeplessness and intense orthopnoea, with severe attacks of cardiac angina. In early life he had had rheumatic fever. The present acute attack had existed for five days. There was a little oedema of the ankles and of the lungs, the arteries were atheromatous, the heart and aorta were enlarged, and mitral presystolic and systolic and aortic systolic and diastolic murmurs were found. The pulse had the characters of aortic regurgitation, with irregularity; the liver was contracted; and the urine was of moderate quantity, free from albumen, and with a specific gravity of 1020. The condition was not one requiring the administration of a cardiac tonic, but rather of opium. So great was the degree of aortic distress that the patient was unable to remain in bed, and endeavoured to obtain rest and sleep at night sitting propped up in a chair. Accordingly, during the first period of his residence in hospital, morphine was frequently injected subcutaneously, and, although it often caused headaches, its effects were much more satisfactory than those of nitro-glycerine and nitrites. As the heart, however, showed symptoms of increasing insufficiency, and the urine gradually lessened in amount, strophanthus was administered to the patient three weeks after his admission. It improved the heart's strength, and reduced its irregularity. It, at the same time, exerted a diuretic



George C.—Immediately before Strophanthus and during Morphine. Pulse 120, respirations 19, per min.



George C.—Second day of *Strophanthus*. Pulse 96, respirations 24, per min.



George C.—Third day of *Strophanthus*. Pulse 88, respirations 18, per min.



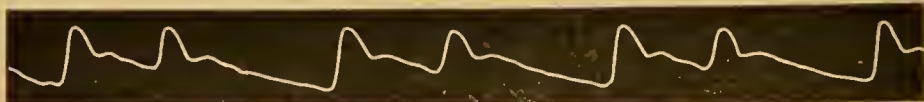
George C.—Eighth day of *Strophanthus*. Pulse 74, respirations 22, per min.

action; for while during the three days preceding its administration the urine amounted to 35, 30, and 44 ozs., on the day following its administration the urine had increased to 116 ozs., on the second day to 130 ozs., and on the fourth day to 56 ozs.; and, coincidentally, the œdema of the legs had almost disappeared. The improvement, however, was only a temporary one. Orthopnoea persisted, and necessitated the use of opium, iodide of potassium, and nitrites, and although latterly digitalis was also administered, the patient died three and a half months after admission. It was found at the post-mortem examination that the lungs were emphysematous, and in a condition of brown induration, that the aortic and mitral valves were incompetent and atheromatous, that the aorta was much dilated, and that the liver and kidneys were in a state of cirrhotic atrophy.

Grave Cardiac Insufficiency without Valvular Lesions.

Fatty Degeneration of the Heart.—It is not, however, only in the cardiac insufficiency of valvular lesions that the members of this group of substances prove of service. Weakness of the heart's action, producing effects similar to those of the weakness resulting from non-compensated valvular disease, may be caused by degenerative changes in the myocardium itself; and whether thus caused or not, it may also occur during pyrexia, and there constitute an important danger to life. Fortunately, in both circumstances, efficient remedies are found among the cardiac tonics. My first illustrations are taken from cases in which the weakness of the myocardium was independent of pyrexia.

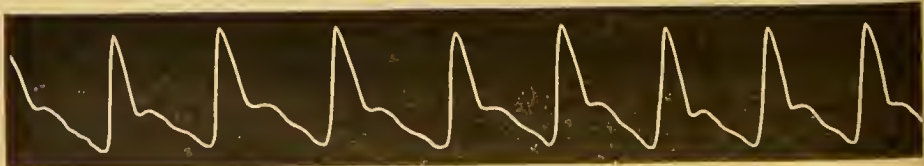
The patient, Henry B., aged 57, a labourer in a coal-pit, came under treatment suffering from œdema of the legs, scrotum, and abdomen, occasional giddiness, general feebleness, and dyspnœa so great that he could only sleep when well propped up in bed. The dyspnœa and feebleness had prevented him from working for four years, and a fortnight before admission they had so far increased that he was unable to leave his bed. The œdema had been present for about the same time. There was no history of rheumatic fever or of intemperance. Examination of the heart revealed considerable dilation of the right side, the apex shock was not visible, the impact could with difficulty be felt, and the heart sounds were extremely feeble, but without any accompaniments. There was also emphysema and moderate enlargement of the liver, with epigastric pulsation; but the urine, though rather scanty in amount, did not contain albumen or any other abnormal constituent. The case appeared to be one of cardiac debility, probably due to steatosis of the myocardium. On the third day after admission, treatment was begun with 5 minims of tincture of strophanthus thrice daily. The condition of the patient gradually improved, so that in eight days he could sleep in a normal posture, and walk about the ward without difficulty; the œdema had disappeared in twelve days, and it was considered unnecessary to continue the treatment longer than three weeks. In six weeks after admission he was sent to the Convalescent Home. The effect in slowing and strengthening the heart's action, and in rendering it more regular, is shown in the following pulse tracings.



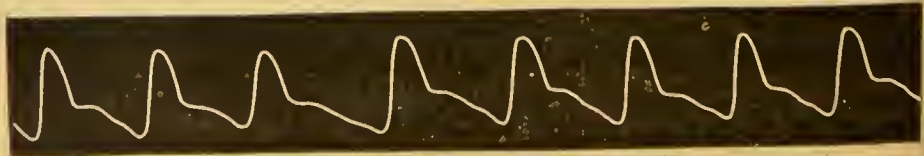
Henry B.—Immediately before Strophanthus. Pulse 96, respirations 34, per min.



Henry B.—Second day of Strophanthus. Pulse 72, respirations 23, per min.



Henry B.—During Strophanthus, twelfth day. Pulse 76, respirations 28, per min.



Henry B.—During Strophanthus, third week. Pulse 76, respirations 23, per min.

The diuretic action of strophanthus was also conspicuously produced in this case. During the three days preceding its administration, the urine was of the average daily amount of 33 ozs. On the day following the first administration, the amount was 80 ozs., on the second day 180 ozs., on the third day 260 ozs., on the fourth day 232 ozs., on the fifth day 136 ozs., on the sixth day 220 ozs., on the seventh day 148 ozs., on the eighth day 134 ozs., on the ninth day 80 ozs.; and, indeed, during the remainder of the patient's residence in the hospital the quantity remained above the average, being generally from 52 to 70 ozs.

Some instruction is to be derived from the after-history of this patient. Soon after going to the Convalescent Hospital, on a cold day, he suddenly became sick, and severe pain was felt in the epigastrium. In a few days afterwards, he died of double pneumonia. At the post-mortem examination it was found that the heart was dilated and fatty, especially in the right side, where also there was some interstitial change, and that no valvular disease existed. The kidneys were found to be in a condition of acute inflammation, with slight chronic cirrhosis.

John N., 64, a hawker, formerly a soldier, was admitted suffering from extreme debility, great dyspnoea, cough, and general anasarca. He had all his life, and especially while following the occupation of a hawker, been exposed to fatigue, inclement weather, and insufficient food; and he admits that he often indulged in large excesses of alcohol. He had not suffered from rheumatic fever.

Three months before admission, he began to be troubled with a cough, and, soon, his breathing became difficult, and the difficulty increased so that he could not lie in bed, but had to be propped up with pillows. His symptoms were temporarily relieved by treatment, but by-and-by the cough became more troublesome, and the dyspnoea so distressing, that he often required to get up at night and sleep on a chair, leaning over a table. During a fatiguing walk, four weeks before admission, his feet and ankles became swollen, and he found himself so feeble that he could complete his journey only at the rate of less than a mile an hour, and he has not since been able to walk.

The œdema having involved the whole body, the patient applied for admission into the Royal Infirmary.

On admission, great dyspnoea was present, and it was soon found that the breathing was, at times, of the Cheyne-Stokes variety. The respirations were rapid, bronchitis with œdema was present, the heart was rapid, weak and irregular in action, and he often suffered from palpitation. The heart was dilated, but no valvular murmur could be discovered, the only abnormalities being a slight prolongation of the second sound in the aortic area, with reduplication and great weakness of the sounds in all the areas. The pulse had the characters of that of mitral lesions, in its restricted

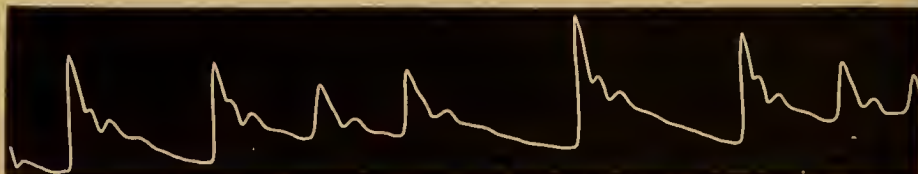
movements, great feebleness, and irregularity in time and amplitude. The urine was scanty, but no albumen or blood was found in it. The liver was moderately enlarged. At 2 A.M. on the night of the patient's admission, the resident physician was called to see him because of an alarming attack of cardiac weakness with much increase of dyspnœa. It was therefore necessary to treat the patient without delay, and alcoholic stimulants were at once administered, with some measure of relief. During the same day, also, he received 5 minims of tincture of strophanthus every six hours, which was continued for forty-eight hours, and the same dose was then administered every eight hours. The heart's action was quickly improved, so that on the second day the rate was about 78 per minute, and the ventricular systole was strong, but irregularity remained; and this irregularity persisted during the two months the patient was under treatment, although other remedies, such as strychnine, were also administered. On the second day,



John N.—Immediately before Strophanthus. Pulse 144 (?), respirations 41, per min.



John N.—First day of Strophanthus. Pulse 128, respirations 27, per min.



John N.—Second day of Strophanthus. Pulse 78, respirations 33, per min.



John N.—Fifth day of Strophanthus. Pulse 56, respirations 39, per min.



John N.—Eighth day of Strophanthus. Pulse 54, respirations 42, per min.

also, the general condition of the patient was greatly improved, and the breathing was easier. On the sixth day, the œdema had disappeared everywhere except at the back of the ankles. It was not until three weeks after admission that the Cheyne-Stokes

breathing had so far lessened as to be observable only while the patient was asleep; and it, as well as irregularity of the heart's action, were the only remaining symptoms when the patient was dismissed from the hospital.

Although the early treatment of the patient rendered necessary by the urgency of the symptoms interferes with the clearness of the evidence, the diuretic return of the remedy was apparently well marked in this case also. On the day of the first administration of strophanthus, only 16 ozs. of urine were passed. On the following day the quantity was 40 ozs., on the third day 30 ozs., on the fourth day 44 ozs., on the fifth day 60 ozs., on the sixth day 68 ozs., on the seventh day 80 ozs., on the eighth day 120 ozs., on the ninth day 110 ozs., on the tenth day 112 ozs., and on the eleventh day 80 ozs.

Fibroid Degeneration of the Myocardium.—The patient, Charles S., aged 51, was admitted on 9th February 1895, suffering from great prostration, swelling of the ankles, dyspnoea, sleeplessness, cough with much wheezing respiration. A complete history could not be obtained because of his condition, but it was ascertained that these symptoms had begun about three weeks ago.

The heart's impact was very feeble, the area of dulness was increased transversely, extending considerably to the right of the sternum, the first sound was extremely feeble, and a faint systolic murmur was heard in the mitral and tricuspid areas; and the pulse was rapid, 130 per minute, and irregular in its rhythm and character. General bronchitis, with considerable pulmonary oedema, and a scanty urine containing much albumen, were also present.

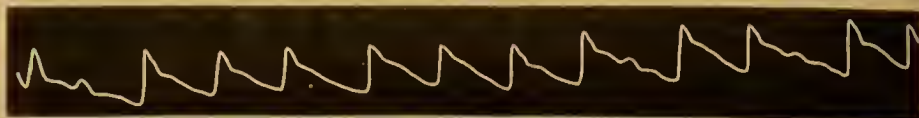
The patient was immediately treated with steam inhalations, poultices, and a cough mixture containing carbonate of ammonium, squill, ipecacuanha and senega; and whisky in small quantities was also administered. Some improvement followed in the breathing and state of general prostration, but as the heart's action did not improve, on the evening of the 12th of February 5 minim doses of tincture of strophanthus were given, and at midnight 10 minims, which latter large dose was repeated every four hours. On the 13th of February, the heart's action was stronger, slower, and less rapid. On the 14th, the improvement was still more marked, the initial rate of 130 per minute having been reduced to 98, while a good pulse expansion with almost perfect regularity had replaced the minute and irregular characters of the pulse of the 12th.



Charles S.—Before Strophanthus. Pulse 130, respirations 38, per min.



Charles S.—First day of Strophanthus. Pulse 120, respirations 25, per min.



Charles S.—Second day of Strophanthus. Pulse 98, respirations 32, per min.

Bronchitis, and especially pulmonary œdema, however, increased, and the patient died suddenly on the 16th of February.

At the post-mortem examination, the diagnosis of enlarged heart, mitral regurgitation, bronchitis, pulmonary œdema, and kidney disease was confirmed. The pulmonary œdema was extreme in both lungs, and had probably been the immediate cause of death.

It was, however, also found that the pericardium was everywhere adherent to the heart, and that extensive chronic myocarditis was present, involving the left ventricle, in patches extending inwards from the pericardium, but nowhere reaching the endocardium, and involving the whole thickness of the wall of the right ventricle from apex to base over a strip from 1 to 1½ inch wide. The coronary arteries and valves were healthy, and the aorta was very slightly atheromatous, but not dilated.

Notwithstanding this extensive degenerative change in the myocardium of both ventricles, the heart reacted well to the action of strophanthus, and a threatened failure of the cardiac action was promptly prevented, although death afterwards occurred from the asphyxia of increasing pulmonary œdema, which, unfortunately, could not be so favourably modified.

Cardiac Insufficiency during Pyrexia.

In order to illustrate the therapeutic effects in the cardiac weakness of pyrexia, the two following cases are given:—

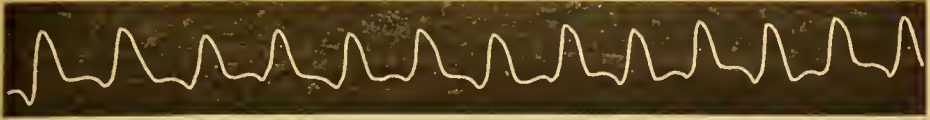
Pneumonia.—In the first, a double pneumonia existed in a young, non-alcoholic man of 29 years, a labourer (Emmanuel F.).

He came under treatment on the fifth day of the illness, and as the pulse was rapid, feeble, and irregular, on the evening of the seventh day tincture of strophanthus was administered in a dose of 5 minims every four hours, which, on the following day, was increased to 8 minims. On the day on which the treatment was commenced, the heart's action was feeble and irregular, but the rapidity of the pulse was not great, as it varied from 104 to 112 in the minute. On the second day of treatment, the pulse had fallen to 94 per minute, and it had become regular in rhythm; and on the fourth day of treatment, the pulse was at the rate of

82 per minute, regular and strong, and the heart's apex beat and sounds had become well marked and distinct.



Emmanuel F.—Seventh day of illness. Before Strophanthus. Pulse 104, respirations 56, per min.



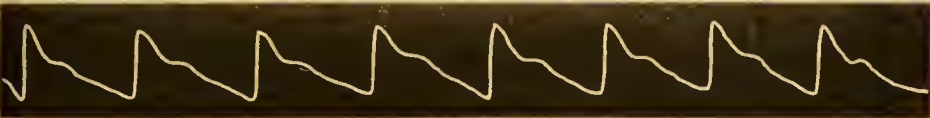
Emmanuel F.—Eighth day of illness. Second day of Strophanthus. Pulse 94, respirations 48, per min.



Emmanuel F.—Tenth day of illness. Fourth day of Strophanthus. Pulse 72, respirations 44, per min.



Emmanuel F.—Thirteenth day of illness. Seventh day of Strophanthus. Pulse 73, respirations 30, per min.



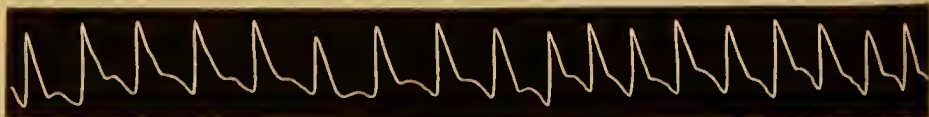
Emmanuel F.—Nineteenth day of illness. Thirteenth day of Strophanthus. Pulse 61, respirations 20, per min.

The progress of the ease continued to be uniformly favourable, and the patient left the hospital in less than five weeks after admission.

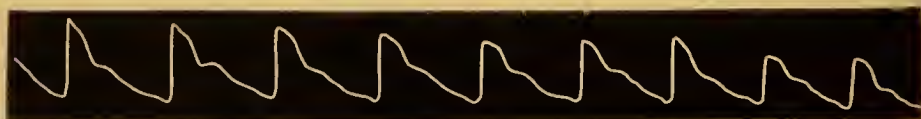
The improvement in the heart's action in this patient happened to coincide with the first evidences of the termination of the stage of pyrexia, and although during the early portion of the period of apyrexia the heart's strength, contrary to what is usually observed, continued to be maintained without diminution, the former circumstance has to be taken into account in estimating the influence of the treatment.

In the following case, on the other hand, the effects on the heart were obtained during the existence of pyrexia. The patient, John R., 40 years of age, was admitted complaining of severe pain in the chest, with cough and fever, all of which had begun with a severe rigor three days before. He was a strong and muscular man, but there was a definite alcoholic history.

Examination showed that the patient was suffering from pneumonia of both lungs, that his breathing was rapid, that the urine did not contain albumen, that the heart's action was very feeble, and that the pulse was frequent, irregular, and of very low tension. General treatment with expectorants and warm moist applications to the thorax was at once adopted, and on the following day half an ounce of brandy was added, because of the feebleness of the pulse. The pneumonia made slow progress; but as the cardiac action became weaker from day to day, it was determined to administer strophanthus. On the day of the first administration, the seventh day of the illness, the pulse was dicrotic and of the very significant rate of 140 per minute, and the temperature ranged from 100° to 102° . On the second day of administration, the pulse was 112 and the temperature between 99° and 101° ; on the third day, the pulse was 84 per minute, with great improvement of strength and entire absence of dicrotism, and the temperature was from $99^{\circ}\cdot 5$ to $100^{\circ}\cdot 5$; and on the fourth day, the pulse, retaining its improved characters, was 76, and the temperature between 98° and $98^{\circ}\cdot 5$. So that, during the existence of pyrexia, an extremely weak pulse of the rate of 140 per minute was in a short time greatly strengthened and its rate reduced to the normal. The after-progress of the patient was favourable, and he left the hospital five weeks after admission.



John R.—Seventh day of illness. Before Strophanthus. Pulse 140, respirations 38, per min.



John R.—Ninth day of illness. Second day of Strophanthus. Pulse 84, respirations 32, per min.



John R.—Eleventh day of illness. Fourth day of Strophanthus. Pulse 76, respirations 30, per min.



John R.—Thirteenth day of illness. Sixth day of Strophanthus. Pulse 78, respirations 28, per min.



John R.—Sixteenth day of illness. Ninth day of Strophanthus. Pulse 66, respirations 22, per min.

I would add that a distinct diuretic action was produced by strophanthus in this case, although the diuresis did not assume the remarkable proportions often observed in cardiac affections with œdema.

Pleurisy.—I have obtained similar satisfactory results in many other cases of pneumonia, as well as in the pyrexia of phthisis and of pleurisy. In the latter disease, I have been in the habit of using strophanthus for two objects,—in order to restore to normal conditions a weak and dicrotic pulse, and in order to prevent, or at least lessen, the likelihood of recurrence of pleuritic effusions after thoracentesis has been performed, by the stimulation of the kidney action.

The successful attainment of the former object has been frequently demonstrated. It is, however, obviously impossible to demonstrate the successful accomplishment of the latter object, as it cannot be predicted in any case of pleurisy that an effusion will reappear. A scanty elimination of urine has, however, in many instances been changed into a copious one; and thus a condition has been produced unfavourable to a re-accumulation of fluid in the pleural cavity.

I have thus illustrated the therapeutical benefits obtained in the treatment of cardiac affections by the administration of substances whose essential action is to increase the contraction of muscular fibre. It is almost unnecessary to point out that they cannot always succeed in relieving the symptoms of heart disease. Failures are only too frequently encountered; but I believe that the therapeutic efficiency of several of these substances is so great that in only three conditions need failure be anticipated, placing out of consideration opposing conditions outside of the heart, such as great œdema of the lungs, extensive bronchitis, and large pleuritic or pericardial effusions, for whose treatment special measures are required. These conditions are, firstly, degenerations of the myocardium so far advanced that adequate contractions of the heart cannot be originated; secondly, mechanical obstructions of the circulation, caused by valve leakage or stenosis so extreme that no possible increase in the strength of the heart's contractions can produce a sufficient circulation of the blood; and, thirdly, a combination of degeneration and of the mechanical effects of valve lesions, where each separately would be insufficient to cause failure, but where the combination is sufficient to do so.

It may be useful to consider the more important of the other members of this group of remedies, in respect, at any rate, to any special characters which they have been found to possess.

So far as experiment has proceeded, strophanthus occupies the first position in the action which is produced on the contractile power of the cardiac muscle. It increases the contraction of this muscle with a smaller quantity than any other similarly acting substance, and with a rapidity unequalled by any of them. Its

energy may be appreciated by the statement, that when a solution containing 1 part of a dry alcoholic extract in 10,000,000 parts of liquid is perfused through the living heart of a frog, the heart is paralysed in extreme systolic contraction in about fifty minutes, and when the solution is one of 1 part of extract in 5,000,000 parts of liquid, such extreme contraction of the cardiac muscle is produced that relaxation occurs only with post-mortem decomposition.

The rapidity of its action finds an explanation in the facts that the active principle is soluble in less than its own weight of water, and that it possesses the diffusibility of a soluble crystalloid.

If, in these respects, it be contrasted with digitalis, it is found that the latter substance has a relatively complex composition, and that several of its active principles are insoluble in water. When the most active of its soluble principles has the energy of its cardiac action tested by passing a solution through the living heart, it is found to have but little effect in a solution of 1 in 50,000, while even a solution of 1 in 5000 is not able to exert on the cardiac muscle so strong an influence as a solution of 1 in 10,000,000 of *strophanthus* extract.

There is, on the other hand, another aspect of the action of these substances in which the advantage may lie with digitalis. The condition of the circulation is dependent not only upon the contractions of the heart, but also upon the state of the bloodvessels. It has long been known that digitalis possesses the power of causing contraction of bloodvessels, and thus of increasing blood-tension. It is not, perhaps, always appreciated that its action in this respect is probably greater than its action on the heart. Its influence on the bloodvessels is due to a direct effect upon them, and is, therefore, produced even when the bloodvessels are entirely separated from the vascular nerve centres. When contrasted with *strophanthus*, the most active of the soluble principles of digitalis exerts at least fifty times a greater contractile power upon bloodvessels than extract of *strophanthus* or than *strophanthin*. While this difference may constitute an advantage in cases where weakness of the circulation is due more to the state of the bloodvessels than to that of the heart, it is not to be overlooked that it may, in the contrary conditions, constitute a disadvantage, by increasing the difficulties to be overcome by an already enfeebled heart. Although it is not within my experience, still it may undoubtedly occur that the relatively feeble action of *strophanthus* upon bloodvessels may somewhat restrict its usefulness as a diuretic. On this point practical experience alone can supply evidence. The diuretic action of heart-remedies of this group cannot be satisfactorily determined by pharmacology. None of them has been clearly shown to possess any diuretic action in health, operating in a definite and constant manner. In disease, their diuretic action chiefly depends on the changes they produce in the circulation of the body and of the kidneys. Any of them that, besides,

exerts a direct action on the excretory structures of the kidneys will be unable to produce diuresis in conditions of the circulation unfavourable to this action. Even those of them that produce diuresis merely by modifying blood-tension may still fail as diuretics in certain derangements of the circulation locally affecting the blood supply of the kidneys. Unfortunately, it is impossible to determine in patients the condition of the kidney blood supply, and, therefore, there must always occur a certain proportion of failures in the diuretic use of each of these remedies, and, therefore, also circumstances, which may be regarded as accidental, are likely to produce erroneous impressions regarding their relative value as diuretic remedies.

But while in some cases a diuretic action may possibly be more successfully obtained by an agent which increases the contractility of the muscles of bloodvessels more than of the muscle of the heart, the contrary is not unusually observed. For instance, in a patient, William W., 64 years of age, suffering from mitral incompetence, with dropsy and dyspnœa, the administration of tincture of strophanthus during seven days failed to increase the quantity of urine above a daily average of 40 ozs.; sodium nitrate, in doses of half a grain four times daily, was then given along with the previous doses of tincture of strophanthus, and on the first day after this addition the quantity of urine was 40 ozs., on the second day 55 ozs., on the third day 104 ozs., on the fourth day 85 ozs., on the fifth day 114 ozs., on the sixth day 115 ozs., on the seventh day 110 ozs., and so on, for several more days.

For similar reasons, it may happen that better results will be obtained by combining together two or more of these substances than by giving one alone, as has been illustrated by Dr Brakenridge in the diuretic effects produced by the combination of digitalis and caffein.

At the same time, disappointments will be produced if it be not apprehended that usually no remarkable diuresis is caused by remedies of this class in the absence of cardiac insufficiency, and that the great flow of urine, such as might occur after the removal of an obstruction or the opening of a sluice, exemplified in several of the cases I have narrated, only occurs when, in patients suffering from cardiac insufficiency, general œdema shows that much liquid has accumulated in the body.

It is unnecessary to make more than a brief reference to the more commonly used of the other substances which possess this fundamental action of increasing the contraction of the heart muscle.

The more important of them are caffein, convallamarin, helleborein, scillitoxin, and adonidin. It may be interesting to remark that when the energy of their action on the heart is determined by perfusion experiments, strophanthus extract is found to be 8 times more powerful than adonidin, scillitoxin and erythrophlein, 20 times more powerful than helleborein, 30 times more powerful than con-

vallamarin, 300 times more powerful than some specimens of digitalin, 3000 times more powerful than others, and 30,000 times more powerful than caffein.

None of them, however, acts so powerfully upon bloodvessels as digitalin.

As to spartein, it slows the heart rather by weakening its systole and thus delaying the cardiac contractions, than by increasing the strength of the contractions. Its action is not, therefore, of the same kind as that of strophanthus and the other substances that act as it does. It has no direct action on the myocardium, but only on its regulating nerves; and even this can be produced only by large doses. By this regulating action, however, it may prove useful in certain forms of cardiac insufficiency, and may also increase the flow of urine.

I have thus made some reference to the more important members of the most important group of cardiac remedies. Notwithstanding the infinite variety of conditions presented by heart diseases, the simple indication for their use is the existence of *cardiac insufficiency*. The selection of any one of them to overcome this insufficiency may be based on considerations such as those which I have stated. It is also to be recollected that the practitioner can generally best use for any definite purpose the remedy in whose use he has most fully trained himself by practical experience. I have, for instance, in my own experience with strophanthus, extending over a large number of cases, never been disappointed in any reasonable expectation; but, because of that gratifying experience, I should be unwilling to assert that successful results are not obtained by other practitioners with some other of these cardiac remedies.

I have not discussed many therapeutic measures which are every day usefully adopted in the treatment of heart diseases, such as special measures for increasing the removal of accumulated liquid, both pharmacological and mechanical, venesection, and, in the absence of marked phenomena of non-compensation, the employment of arsenic, strychnine, and graduated physical exercise. In association with these latter measures, and exceeding them all in importance, I would, in conclusion, enforce the importance of *rest*. It is not only a requisite in the more severe, but also in the mildest forms of non-compensated cardiac disease; and it has over and over again come under my observation that, with the simple aid of a regulated dietary, it has been sufficient to remove, not only the cardiac symptoms of mild non-compensation, but also those of more aggravated cardiac insufficiency, including even oedema of a limited part of the body. And by *rest* I also mean the avoidance of the unnecessary exertion of the heart, only too frequently produced by the administration of digitalis, or some other similar substance, whenever a cardiac bruit is detected, and without due regard to the actual requirements of the circulation.